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1986 AIR QUALITY DATA SUMMARY REGIONAL MUNICIPALITY OF WATERLOO AND THE COUNTY OF WELLINGTON

NOVEMBER, 1987

Ministry of the Environment
Ontario

B.I. BOYKO, Director
West Central Region

1986 AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF WATERLOO AND THE COUNTY OF WELLINGTON

Ministry of the Environment
Air Quality Assessment
F. Dobroff
West Central Region

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ABSTRACT

This report summarizes the results of air monitoring in the Regional Municipality of Waterloo and County of Wellington in 1986.

General ambient air quality as characterized by stations in Guelph and Kitchener was very good.

Monitoring near industrial sources showed some local air quality problems exist and include:

1. Dolime quarry in Guelph where particulate emissions have occurred. Controls will be installed later in 1987.

2. Breslube in Breslau where upsets and fugitive emissions have caused odours. Attempts are being made to reduce these problems.

RÉSUMÉ

Ce rapport présente un bref résumé des résultats de l'évaluation de la qualité de l'air entreprise en 1986 dans la municipalité régionale de Waterloo et le comté de Wellington.

Comme l'indiquent les relevés effectués par les stations de Guelph et de Kitchener, la qualité générale de l'air ambiant était très bonne.

Les contrôles réalisés à proximité des sources industrielles ont révélé l'existence de certains problèmes localisés de qualité de l'air, notamment :

1. La carrière Dolime de Guelph, où des émissions de matières particulaires se sont produites. Des mesures de contrôle seront mises en oeuvre dans le courant de 1987.

2. Breslube de Breslau, où des renversements et des émanations passagères ont entraîné des odeurs. Des mesures ont été prises pour réduire ces problèmes.

INTRODUCTION

This report summarizes the results of air monitoring in the Regional Municipality of Waterloo and the County of Wellington in 1986.

The Ministry of the Environment's West Central Region has conducted routine monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives. These in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to ensure that air quality objectives are being met and to observe trends in air pollution.

MONITORING NETWORK

The Ministry of the Environment's West Central Region operates a network of monitors in the area in Ayr, Breslau, Elmira, Guelph and Kitchener. Much of the monitoring is performed near industrial sources, in many cases, as a response to local complaints. Monitoring of a more general nature is also carried out at single stations in Guelph and Kitchener to characterize air quality in larger population centres.

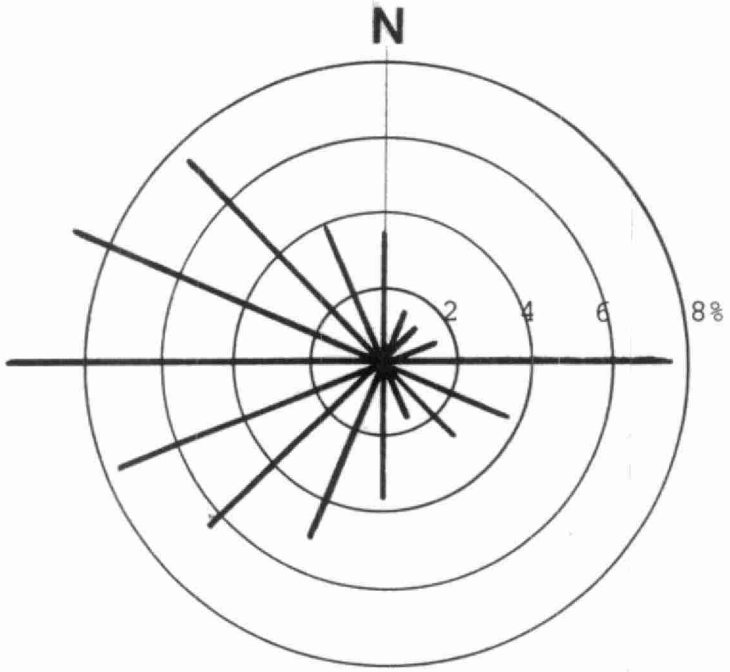
Meteorological data (wind speed and direction) are not measured by the Ministry in the area. However, data measured by Environment Canada at the Waterloo-Wellington Airport is provided to the Ministry for data analysis. Figure 1 illustrates the wind frequency distribution for the area and shows that winds from the southwest, west and northwest quadrants predominate almost 50% of the time. Consequently, wherever possible, stations are located "downwind" of suspected pollution sources with respect to these winds.

Wind data were utilized in a computer program known as a "pollution rose" - essentially a cross-tabulation of average hourly pollutant concentrations with wind direction. The data from this program are illustrated on various maps in this report and are a useful tool in determining the impact on any given source on a monitoring station. The length of each line of the "rose" is proportional to the average concentration when the wind was blowing from that direction.

FIGURE 1

WIND FREQUENCY DISTRIBUTION - 1986

WATERLOO-WELLINGTON AIRPORT



Lines indicate direction wind blew <u>from</u>

POLLUTANTS MONITORED

Two basic types of air pollutants are measured-gases and particulates (dust).

a) Gases measured with continuous analyzers include:

- Sulphur Dioxide (SO_2) - monitored in Guelph and Kitchener for general ambient levels. SO_2 is a product of fuel combustion. Air quality criteria and their underlying limiting factors are:

1-hour average	- .25 ppm (vegetation effects)
24-hour average	- .10 ppm (health effects in conjunction with particulates)
1-year average	- .02 ppm (vegetation effects)

- Carbon-Monoxide-(CO) - general ambient levels are measured in Kitchener. The major source of CO is the automobile. Criteria for CO are:

1-hour average	- 30 ppm (health effects)
8-hour average	- 13 ppm (health effects)

- Ozone (O_3) - measured in Kitchener and Guelph to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight and ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual and daily trends with highest levels occurring during the summer, and daily maxima usually occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distances and can be augmented by local sources. Most of the high levels

measured in Southern Ontario each summer arrive from the United States. An objective for ozone is:

1-hour average - 80 ppb (vegetation effects)

- Oxides of Nitrogen - general ambient levels were measured in Kitchener. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Criteria exist only for NO_2:

1-hour average	- .20 ppm (odour)
24-hour average	- .10 ppm (health effects)

b) Particulates (dust) were measured by two methods, each relating to a different size range of particles.

- Dustfall - heavy material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere by gravity. A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. Criteria are:

1-month average	- 7.0 g/m^2/30 days (nuisance effects)
1-year average	- 4.5 g/m^2/30 days (nuisance) effects)

- Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24 hour period. The exposed filter is weighed and the weight of solids collected is converted to an equivalent concentration in air.

Units used are micrograms per cubic metre. The samplers run once every six days. Criteria based on health effects in conjunction with sulphur dioxide are:

24-hour average	- 120	ug/m^3 (health effects)
1-year geometric mean	- 60	ug/m^3 (health effects)

DATA ANALYSIS

Ayr

Dustfall has been measured at station 26026 - Stanley St. near the Date Industries Foundry since 1976 (Figure 2). Past data had shown extremely high dustfall concentrations well above objectives. However, in-plant surveys had revealed no obvious evidence of continual emissions. Short periodic emissions have been witnessed, however.

In 1986, it was discovered that an improper siting of the sampler had caused the high readings. The jar had been sitting directly beneath a set of hydro transformers from which rainwater washed particulates into the jar.

In October, the jar was moved a few poles west down Stanley St., free of interferences and consequently the final three samples of the year all met the yearly objective (Table 7).

Monitoring will continue in 1987 to further ascertain actual dustfall levels near this foundry.

Breslau

Dustfall near Breslube measured at station 26036 on Fountain Road (Figure 3) improved marginally in terms of yearly average (Table 7). However, the monthly objective was exceeded five times, compared to twice in 1985.

The greatest potential source of dust at Breslube use to be storage piles of lime. In 1985 these piles were newly enclosed in a storage bin and this seemed to reduce the impact on local air quality. An improvement in 1985 is apparent in the trend graph (Figure 4). The source of the elevated monthly readings is unknown, however, traffic on Fountain Road may be a factor.

The samples were analyzed for calcium (lime is calcium carbonate) and higher concentrations were found in 1986 than

FIGURE 2

Ayr Air Monitoring Station

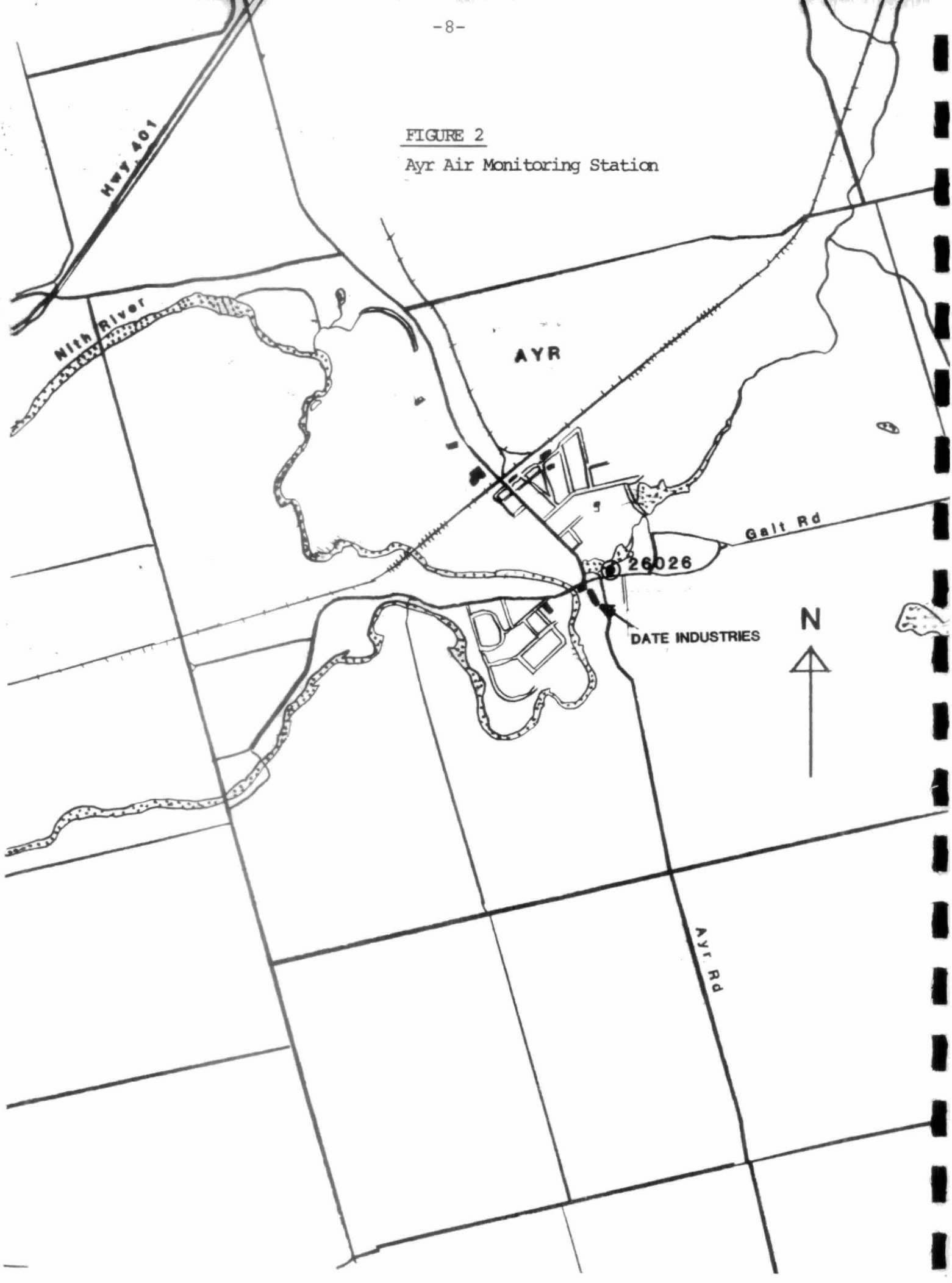


FIGURE 3
Breslau Air Monitoring Station

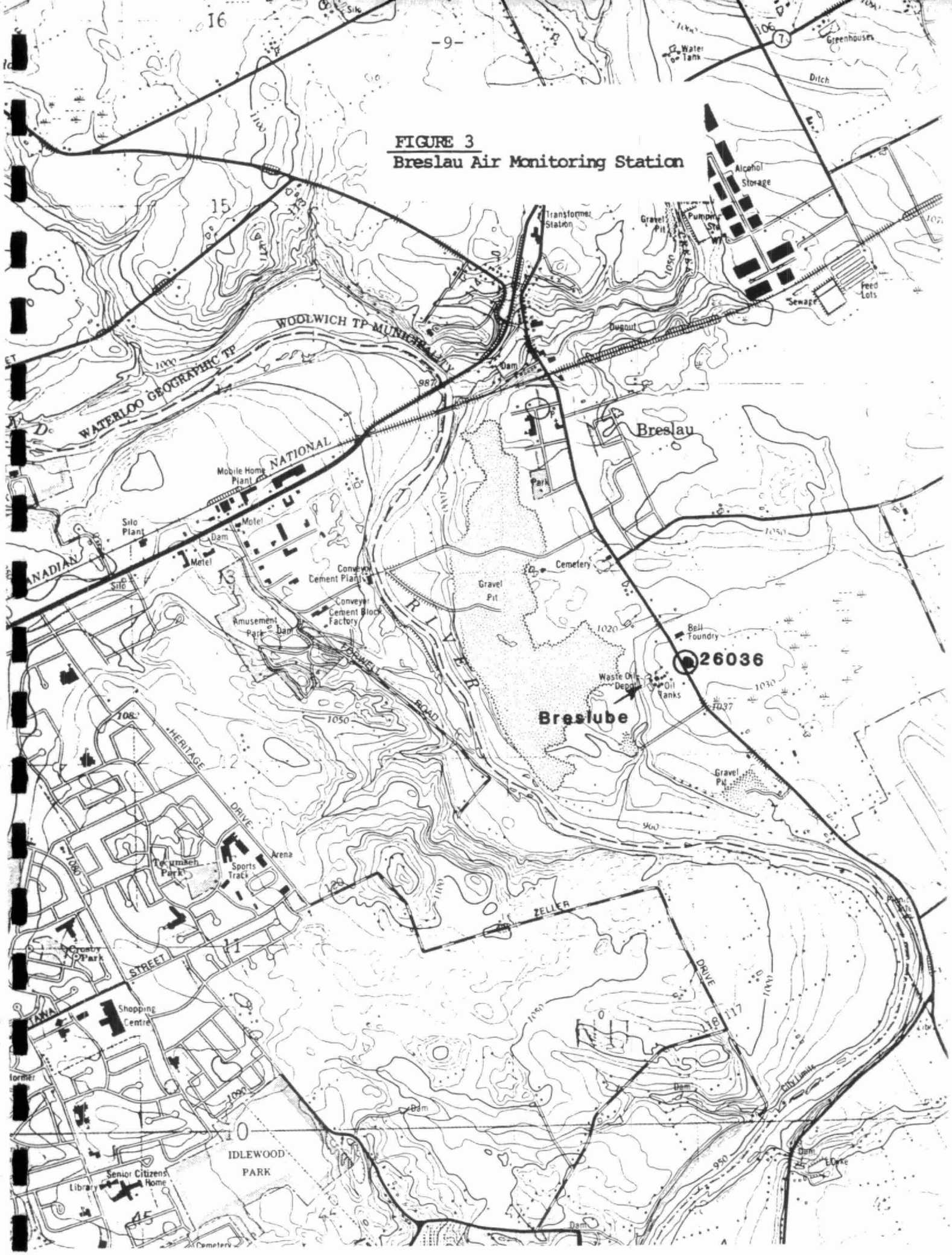
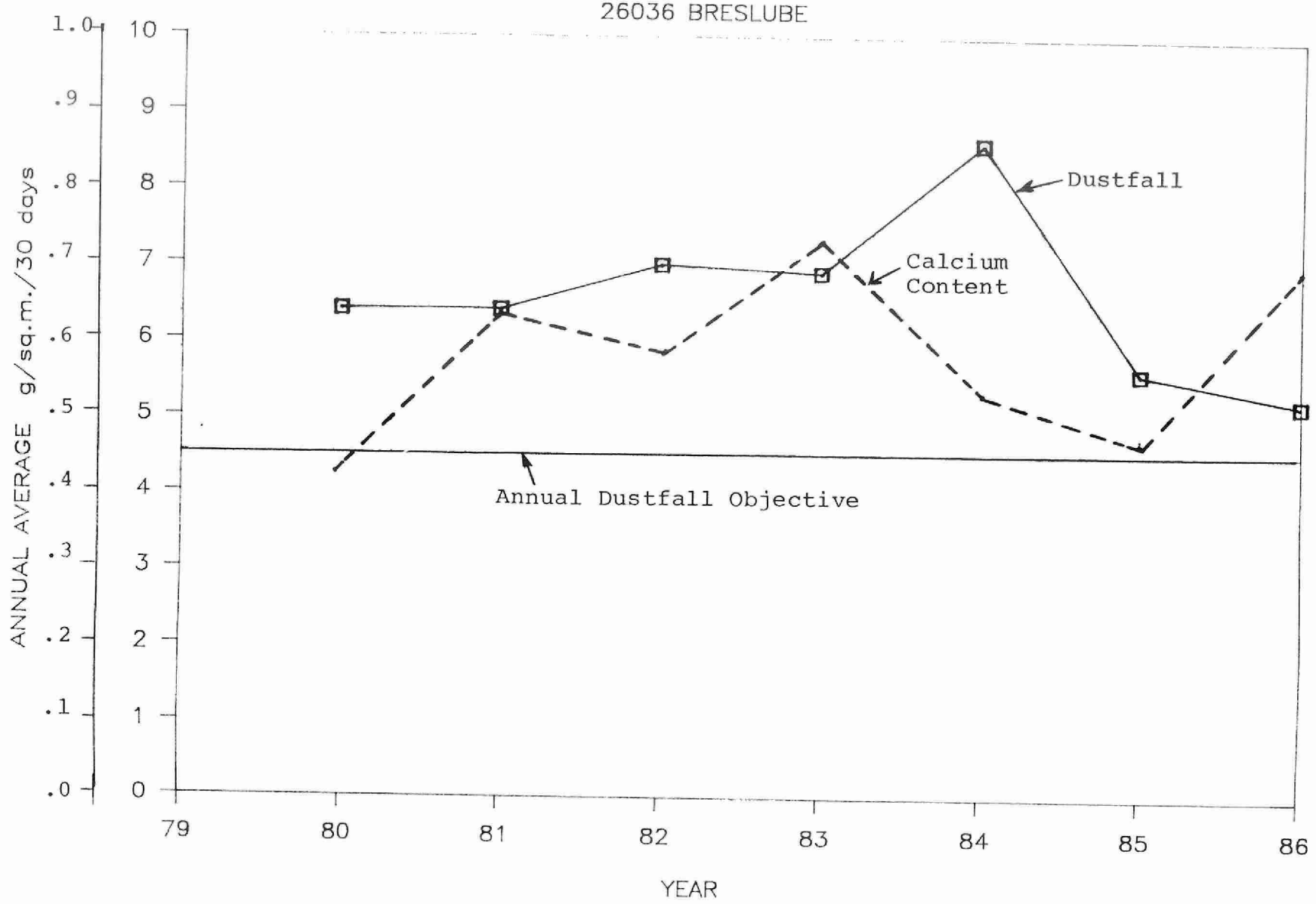


FIGURE 4

DUSTFALL YEARLY TREND

26036 BRESLUBE



in 1985, converse to the dustfall average. On a month by month basis, however, the calcium levels still correlated very well with the total loading data. The calcium data are given in Table 8.

Process emissions from Breslube appear to be under control, barring upset conditions and fugitive emissions, but it should be noted that upsets can occur frequently, and cause odour problems in the vicinity of the plant and a large area of Kitchener. Attempts are being made to minimize these problems. In 1985, a new vacuum distillation system was brought on line and it was thought that this installation improved air quality. In 1986, several other modifications and procedures were instituted in response to a plant survey.

Guelph

The main station was moved from 28025 - Farquhar/Wyndham to 28028 - Exhibition Park in January 1986 (Figure 5). Sulphur dioxide measured at station 28028 continued to record mostly very low levels and all objectives were met (Table 1). The pollution rose in Figure 6 indicates highest average concentrations (albeit very low) arrived from the southeast. The SO_2 trend graph in Figure 7 illustrates the low stable concentrations measured here since 1981, well below the annual objective.

Ozone was newly monitored at station 28028 in 1986 and data are summarized in Table 2. The hourly ozone objective was exceeded during 24 hours, all during the spring and summer. Ozone is mainly a photochemical product of the chemical reaction between nitrogen oxides and certain hydrocarbons in the presence of sunlight. The pollution rose given in Figure 8 shows that highest averages occurred during south-southwest winds. The high levels when they occurred were largely imported from the United States and were high concurrently throughout Southern Ontario.

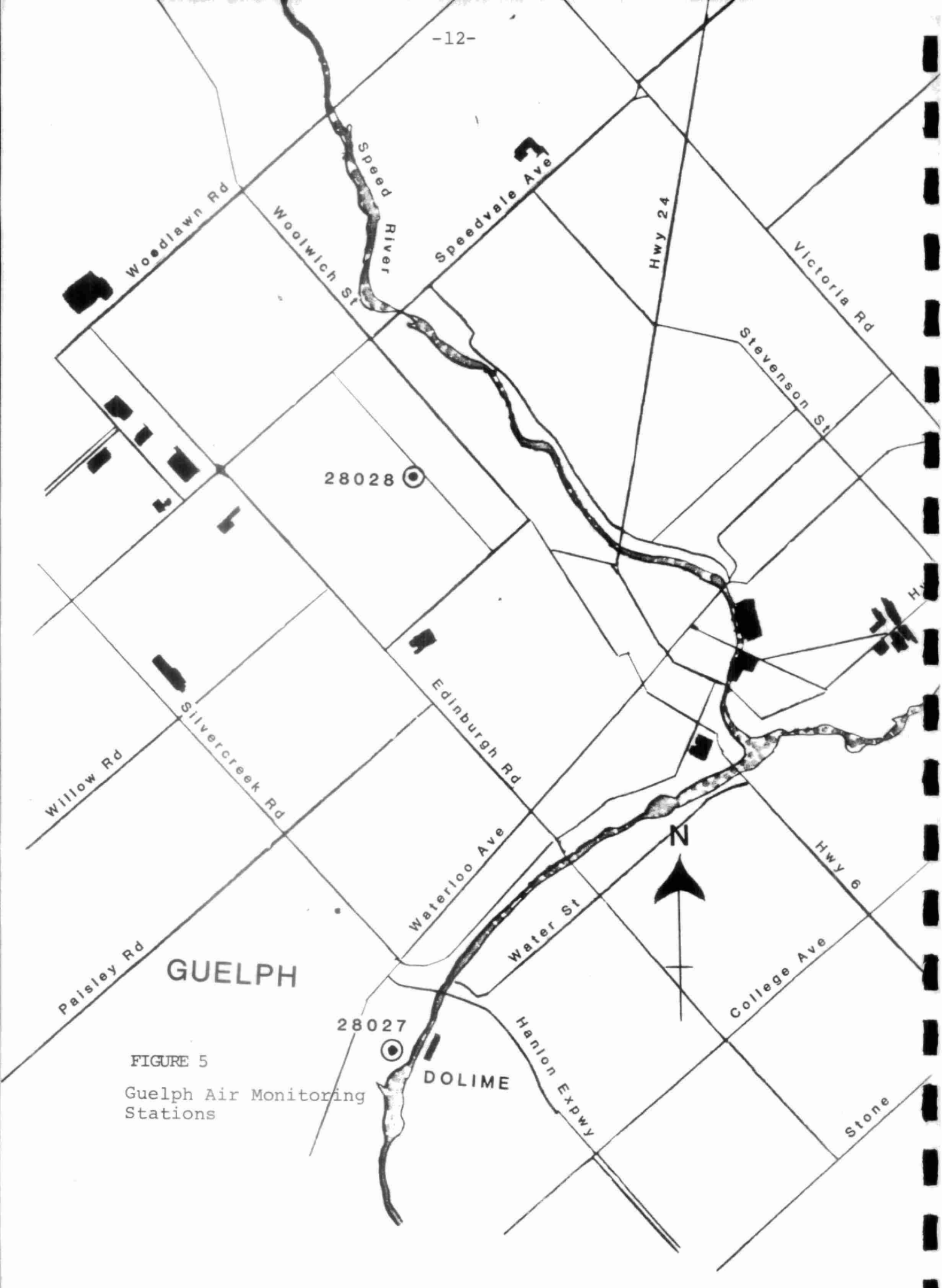


FIGURE 5

Guelph Air Monitoring Stations

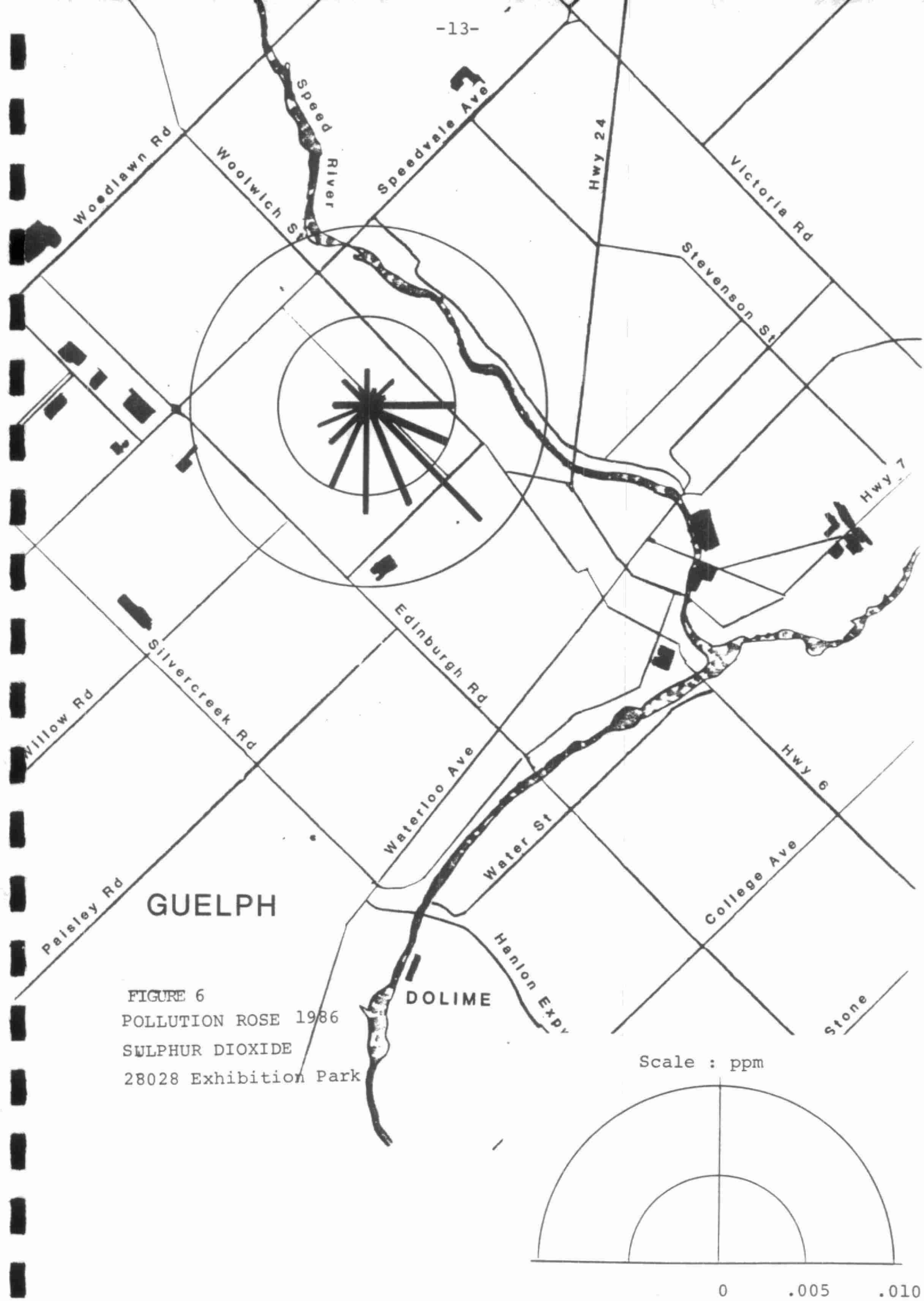
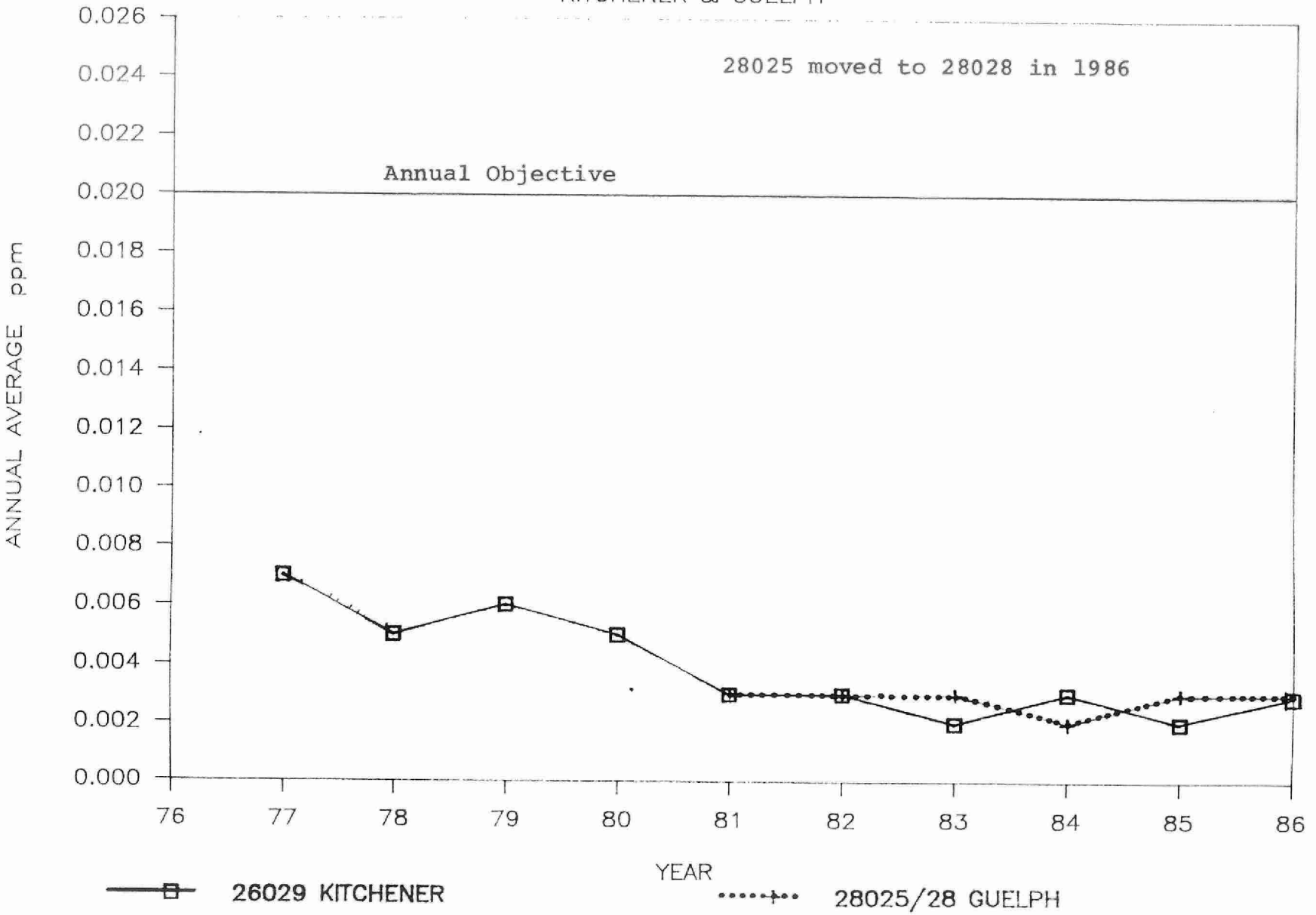


FIGURE 6
POLLUTION ROSE 1986
SULPHUR DIOXIDE
28028 Exhibition Park

FIGURE 7

SULPHUR DIOXIDE YEARLY TREND

KITCHENER & GUELPH



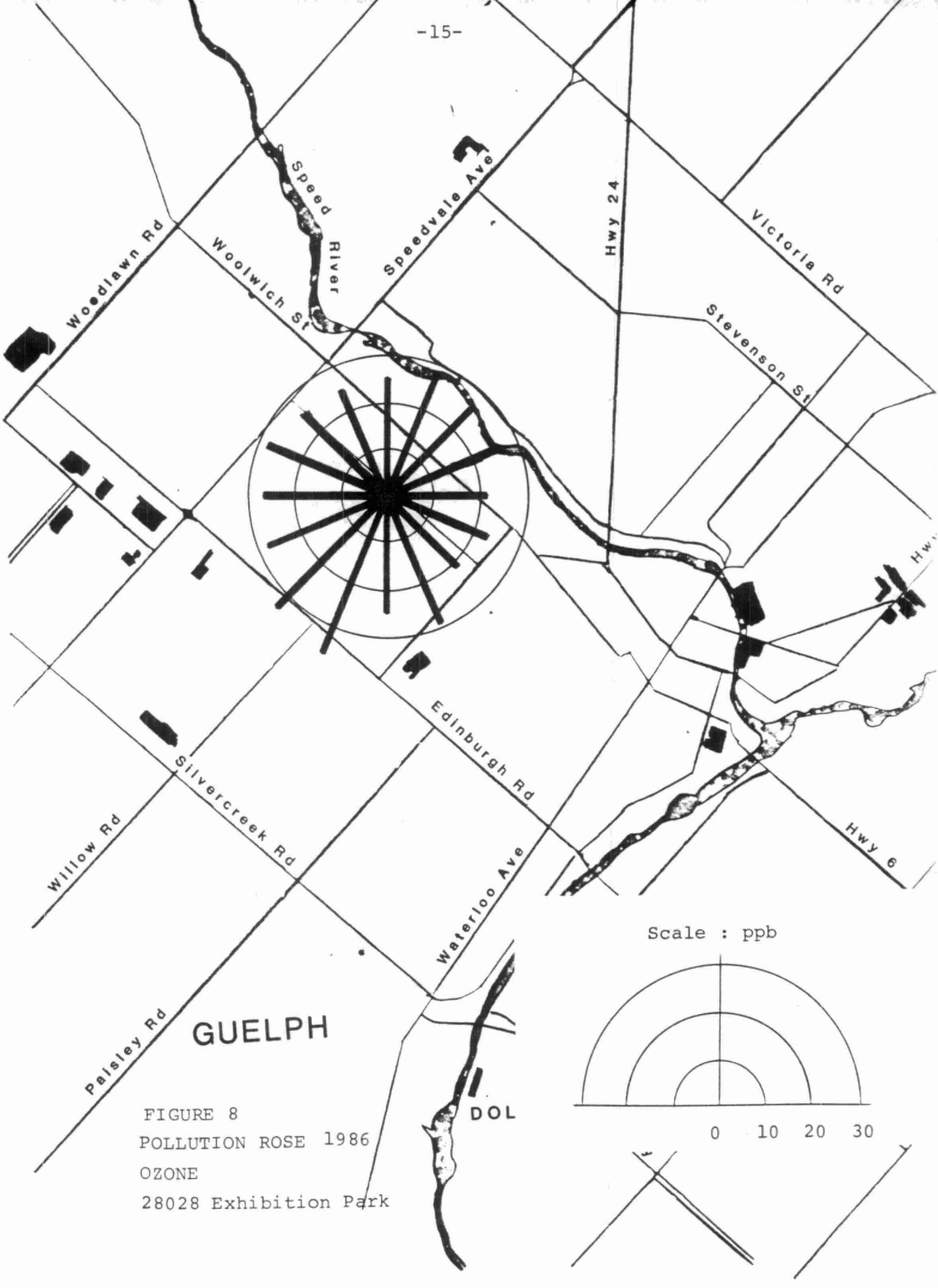


FIGURE 8
POLLUTION ROSE 1986
OZONE
28028 Exhibition Park

It should be noted that the peak of the pollution rose is not overly prominent compared to the other wind directions. This is because the rose was computed for the entire year and southerly winds do not automatically yield high ozone, even during the summer. Specific meteorological conditions are necessary.

Suspended particulate concentrations measured at 28028 were very low year-round, similar to levels in rural areas (Table 5). There were no samples which exceeded the daily objective.

Interestingly, the trend graph for suspended particulates in Figure 9 shows that the Guelph and Kitchener stations display identical trends from 1981 to 1986. The variations which occur then are likely due to mesoscale phenomena, i.e., long range transport of particulates into the area from distant sources.

Suspended particulate concentrations were also measured near Dolime (a lime quarry operation) at station 28027 at the sewage treatment plant on Waterloo Ave. (Figure 5). Concentrations improved from 1985, falling below the yearly objective (Table 5). Five samples out of 58 exceeded the daily objective, all on days of east or southeast winds. Correlation of the data with wind direction indicated fairly strong correlationships with east and southeast winds, ie., from Dolime.

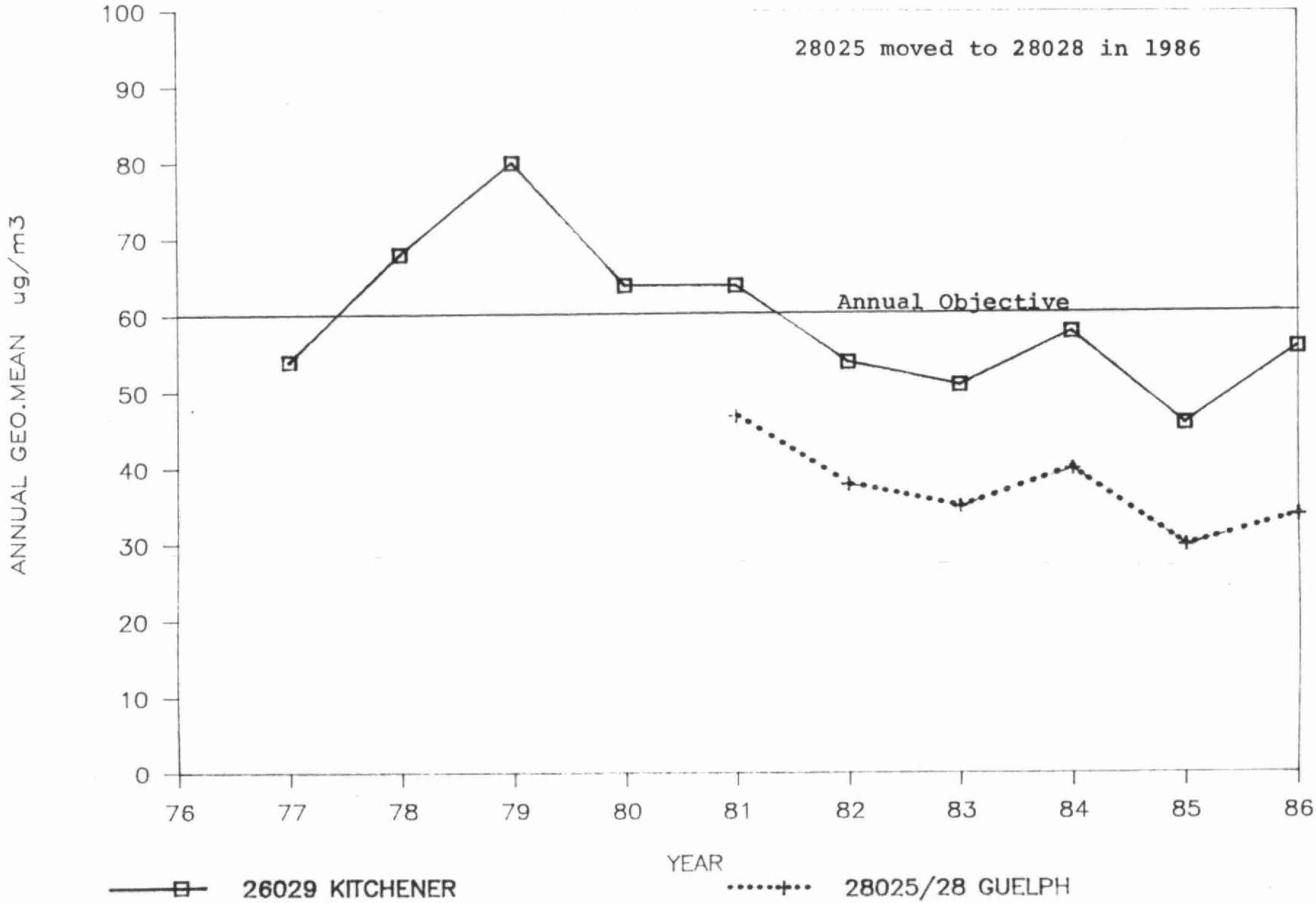
The filters were also analyzed for carbonate (lime is calcium carbonate) and summary statistics are given in Table 6. The carbonate concentrations correlated fairly well with the suspended particulate readings, further confirming Dolime to be the major source of particulates in the area.

The sources of particulate emissions at Dolime are their lime kilns. As a result of a Control Order served on Dolime in 1986, the company is installing scrubbers on the lime kilns

FIGURE 9

SUSPENDED PARTICULATES YEARLY TRENDS

KITCHENER & GUELPH



which should be operational by October 1987. Fugitive emissions are also to be addressed and abatement measures may be taken by the spring of 1988.

Kitchener

The main monitoring station 26029 at Edna and Frederick (Figure 10) continued to show acceptable levels of sulphur dioxide, carbon monoxide and nitrogen dioxide meeting all criteria (Tables 1, 3 and 4). Trend graphs in Figures 11, 12 and 13 illustrate stable levels dating back to 1977.

Ozone concentrations (Table 2) also remained relatively unchanged, with 33 hours above the hourly objective. The trend graph of exceedence events in Figure 14 shows random variation from year to year, which is mostly related to weather variability, that is, temperatures and quantities of sunshine each summer, when all exceedences occur.

Pollution roses are presented in Figures 15 to 18 and with the exception of ozone, all peaks occurred under northeast, east or southeast winds - from the adjacent Conestoga Parkway.

The rose for ozone (Figure 18) peaks under south-southwest winds, similar to Guelph. When levels were high they were high at the same time in both cities together with the rest of Southern Ontario. Ozone is mainly a photochemical product of long range transport of precursor pollutants (hydrocarbons and oxides of nitrogen) from the United States. It should be noted that southerly winds do not automatically carry high ozone, even during the summer. Specific meteorological conditions are necessary. This accounts for why the peaks of the pollution roses are not overly prominent, compared to the other directions.

Suspended particulates measured at Edna and Federick were marginally higher than in 1985 (Figure 19), a trend generally common to the Region. The yearly objective was not exceeded, and there were only two samples above the daily objective

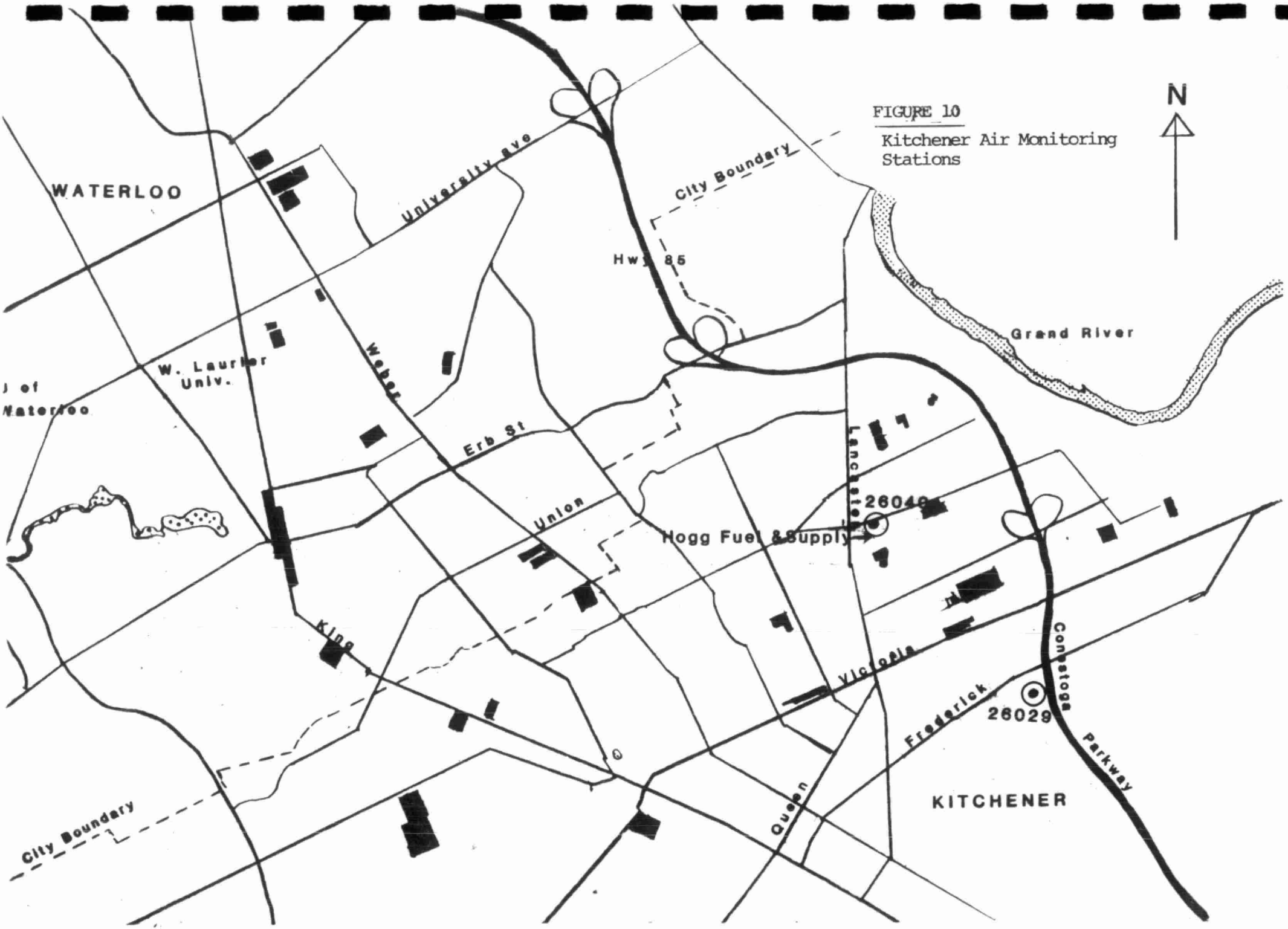


FIGURE 10

Kitchener Air Monitoring Stations

FIGURE 11

SULPHUR DIOXIDE YEARLY TREND

KITCHENER & GUELPH

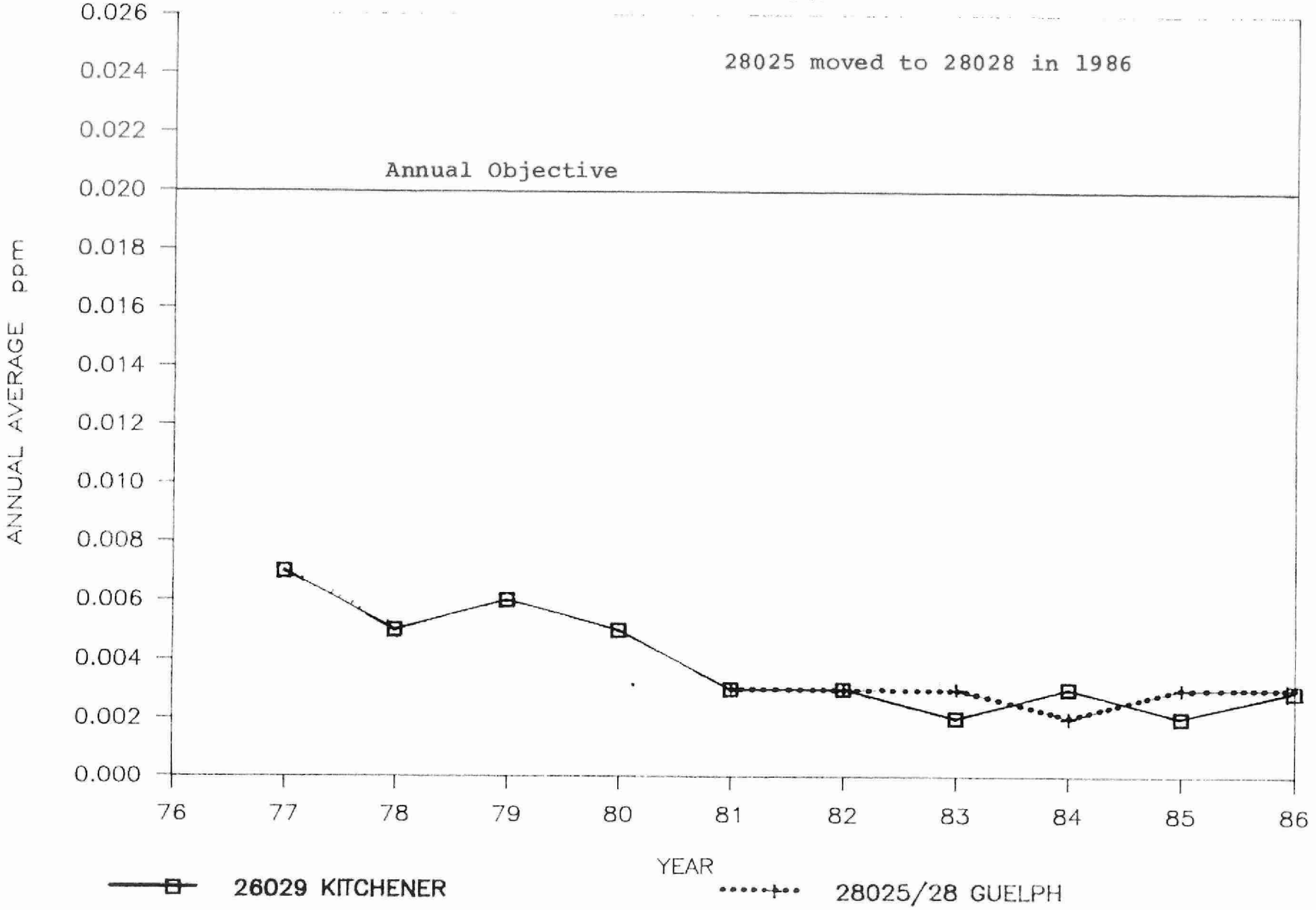


FIGURE 12

CARBON MONOXIDE YEARLY TREND

26029 KITCHENER

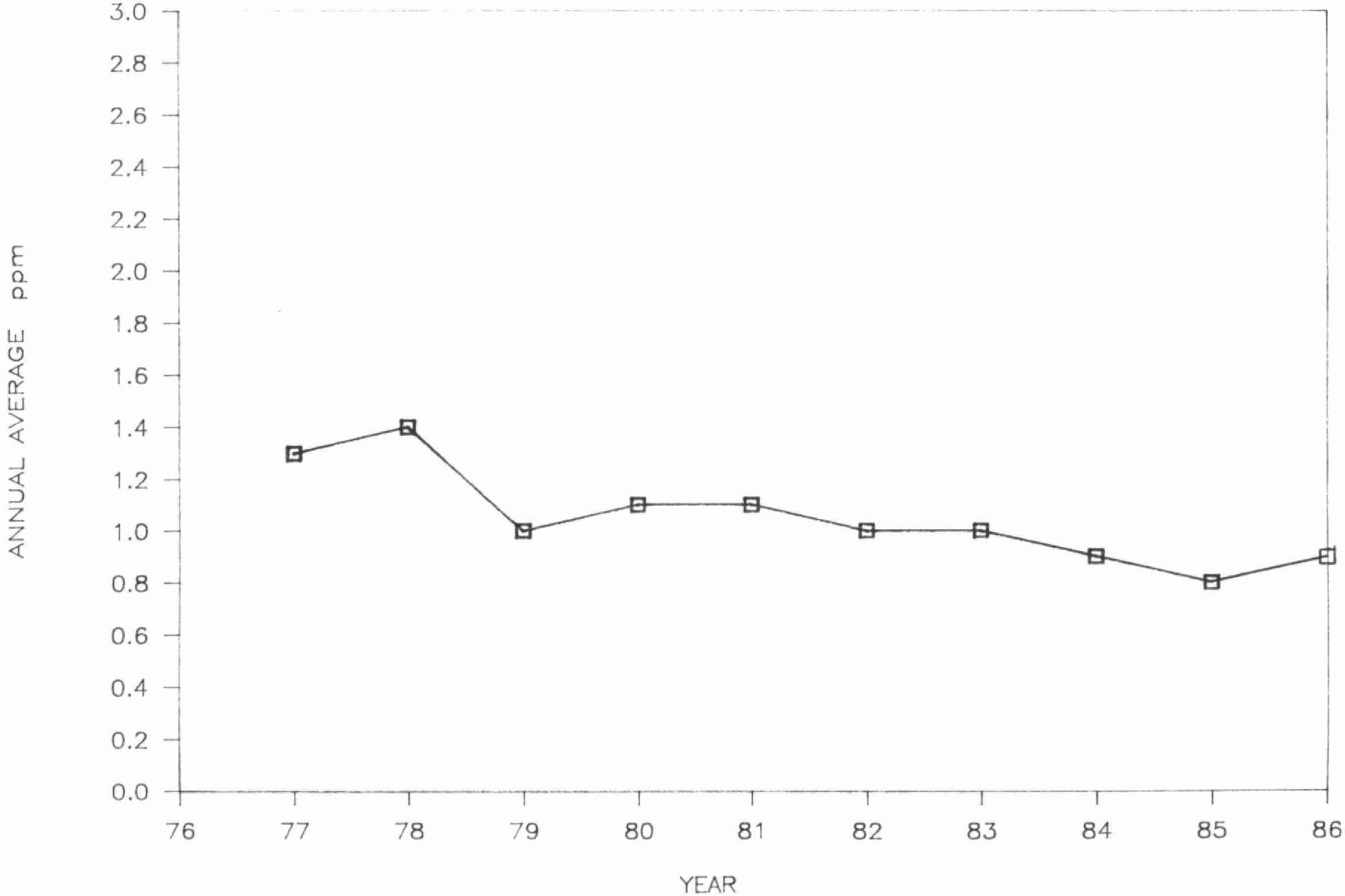


FIGURE 13

NITROGEN DIOXIDE YEARLY TREND

26029 KITCHENER

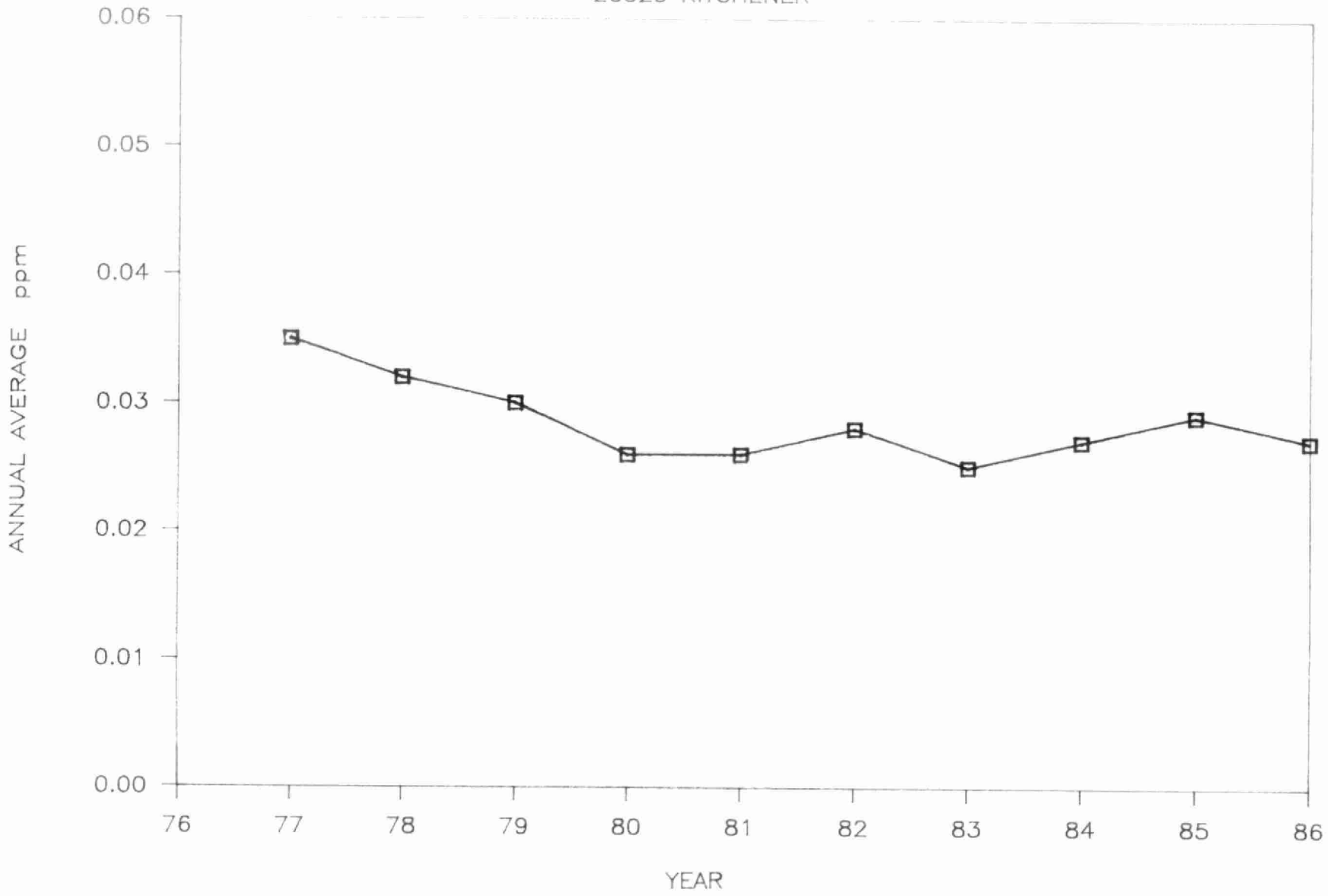
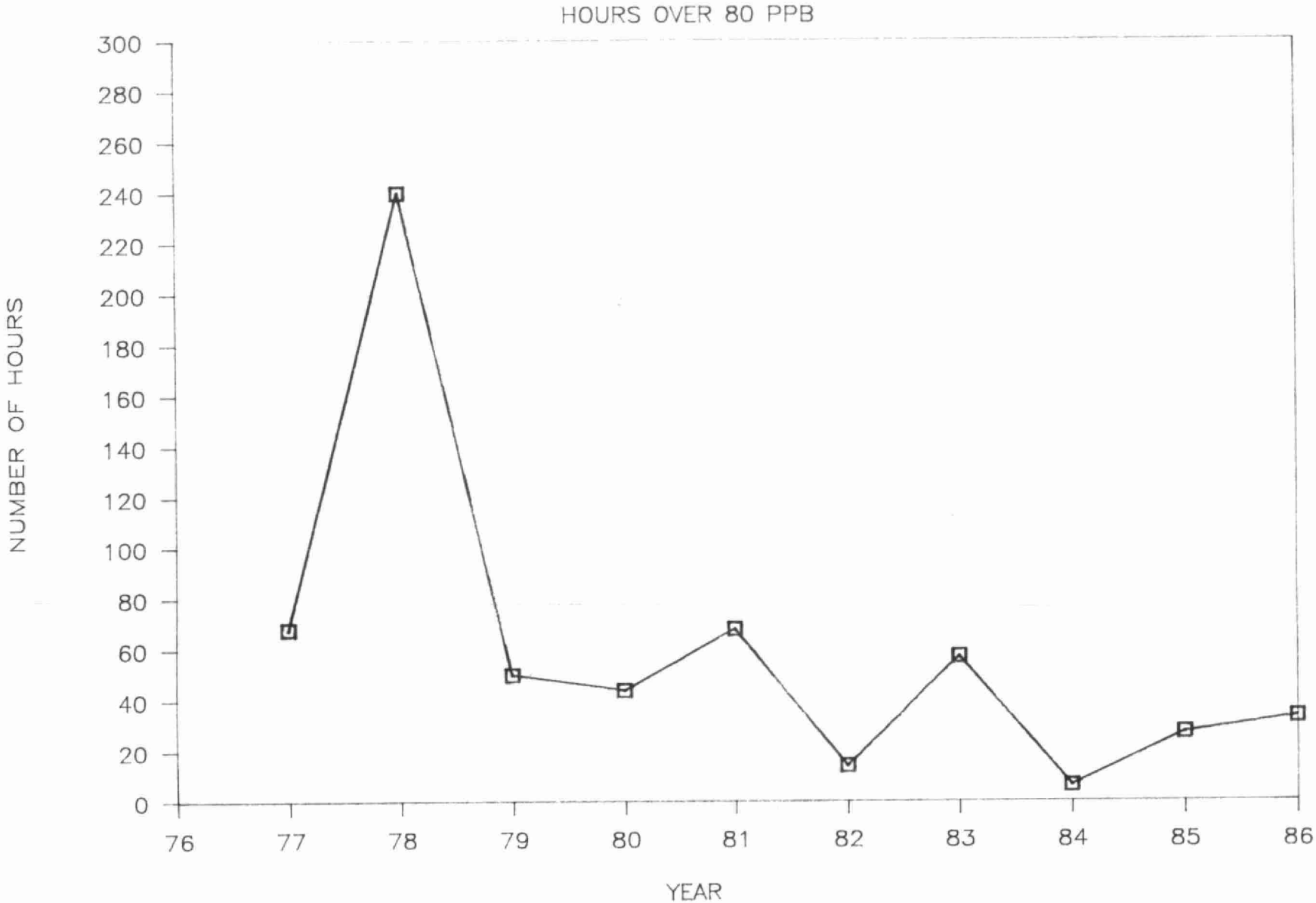


FIGURE 14

OZONE EXCEEDENCE TREND--KITCHENER



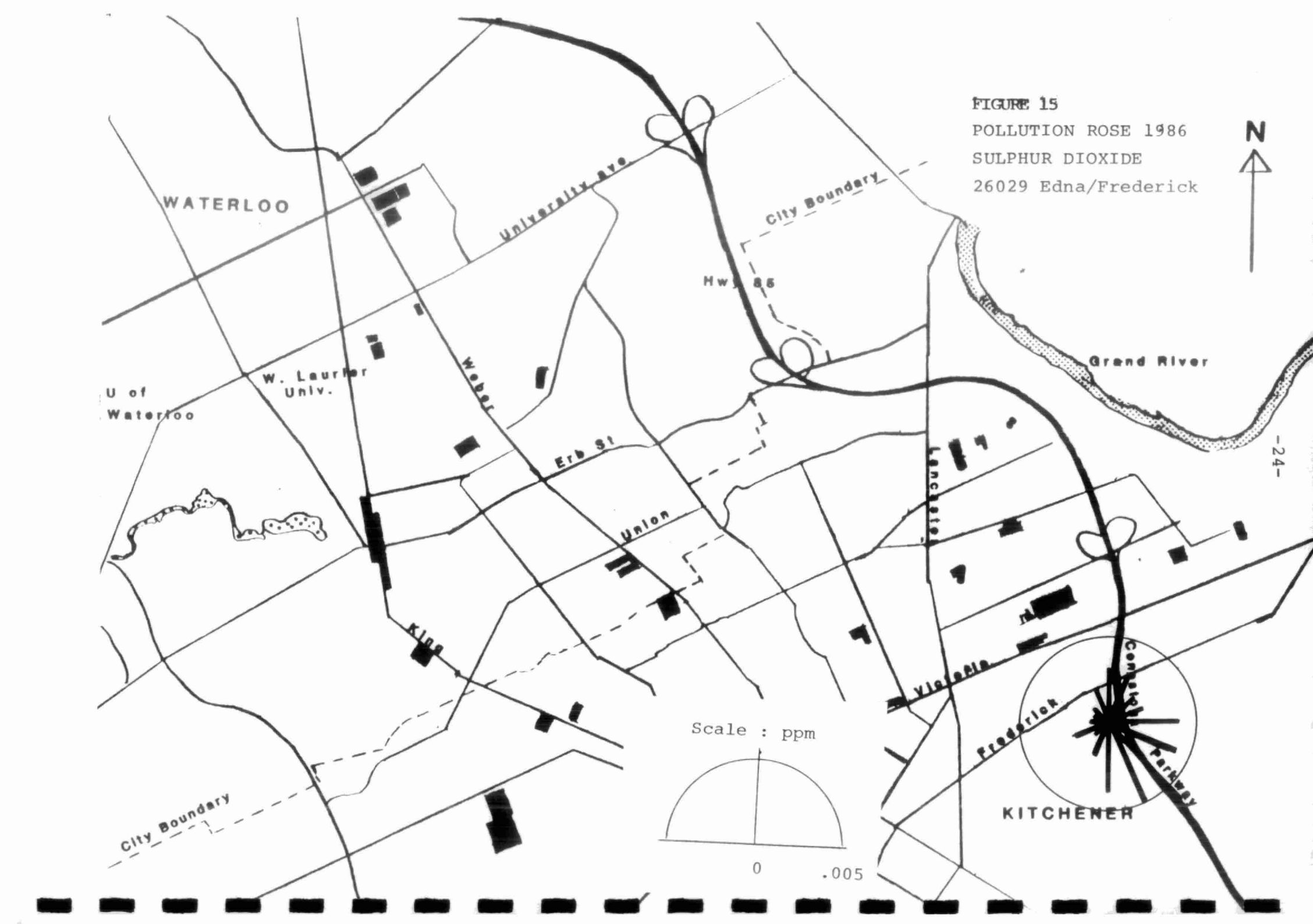


FIGURE 15
POLLUTION ROSE 1986
SULPHUR DIOXIDE
26029 Edna/Frederick

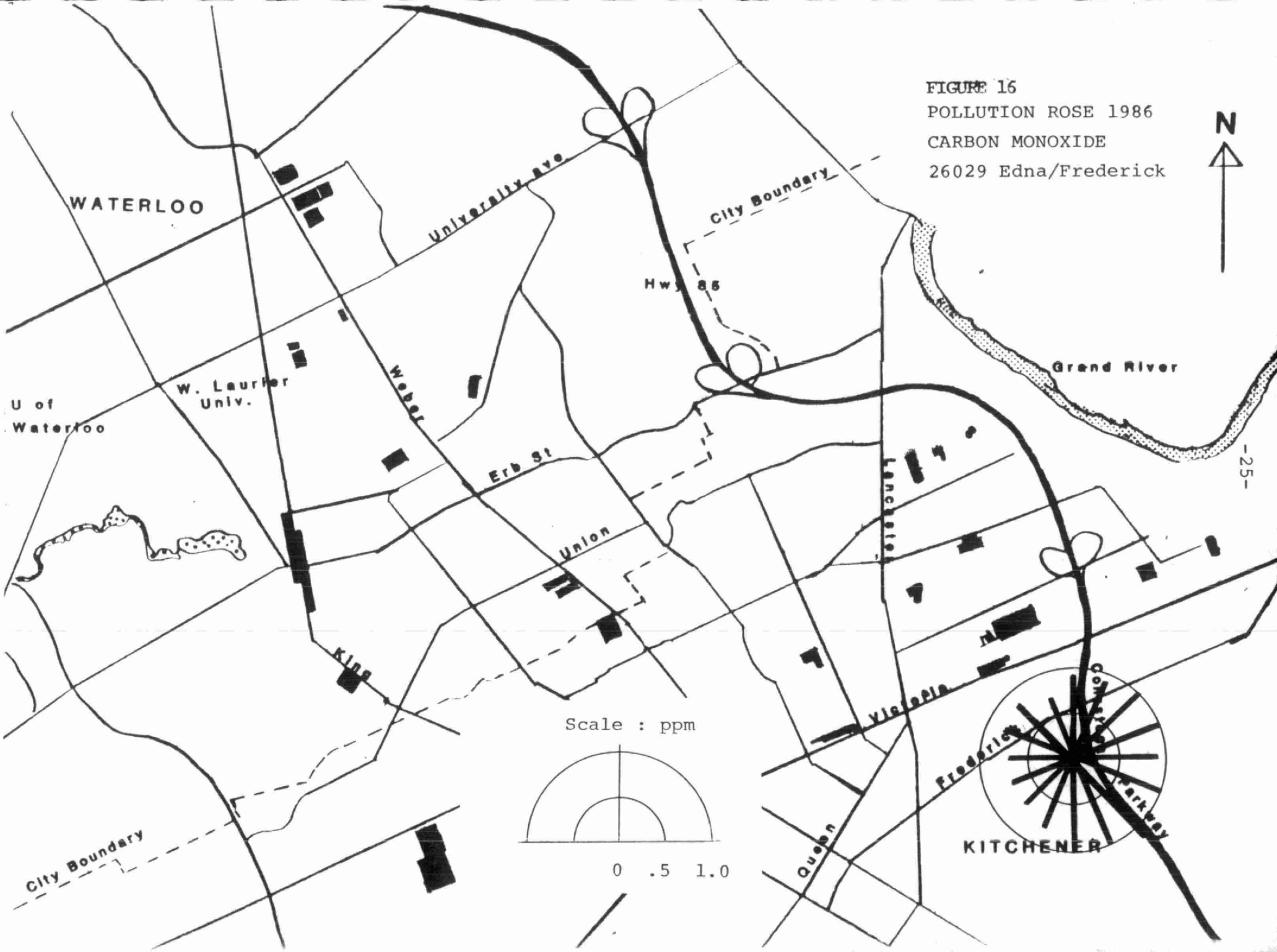


FIGURE 16
POLLUTION ROSE 1986
CARBON MONOXIDE
26029 Edna/Frederick

FIGURE 17
POLLUTION ROSE 1986
NITROGEN DIOXIDE
26029 Edna/Frederick

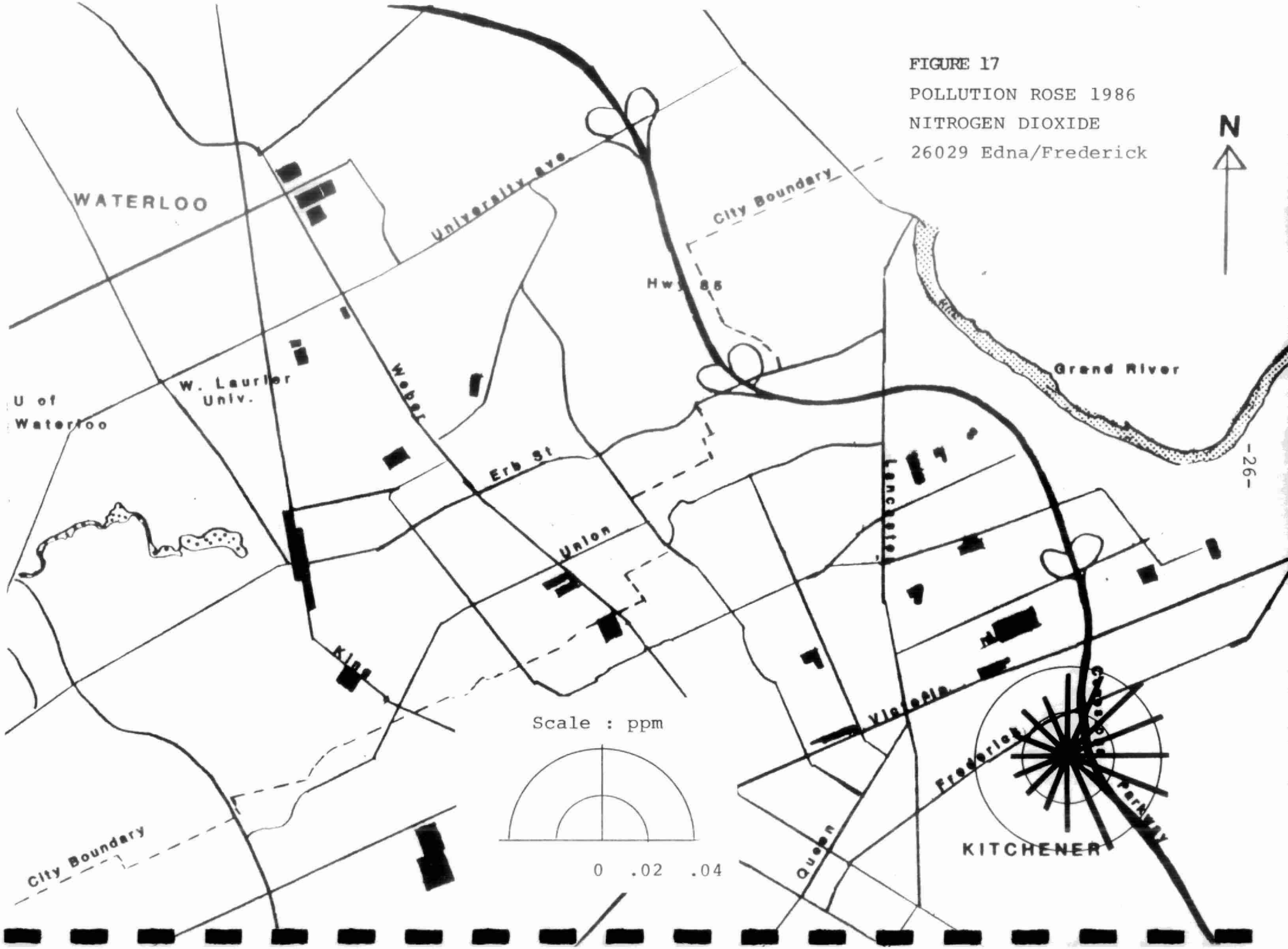


FIGURE 18
POLLUTION ROSE 1986
OZONE
26029 Edna/Frederick

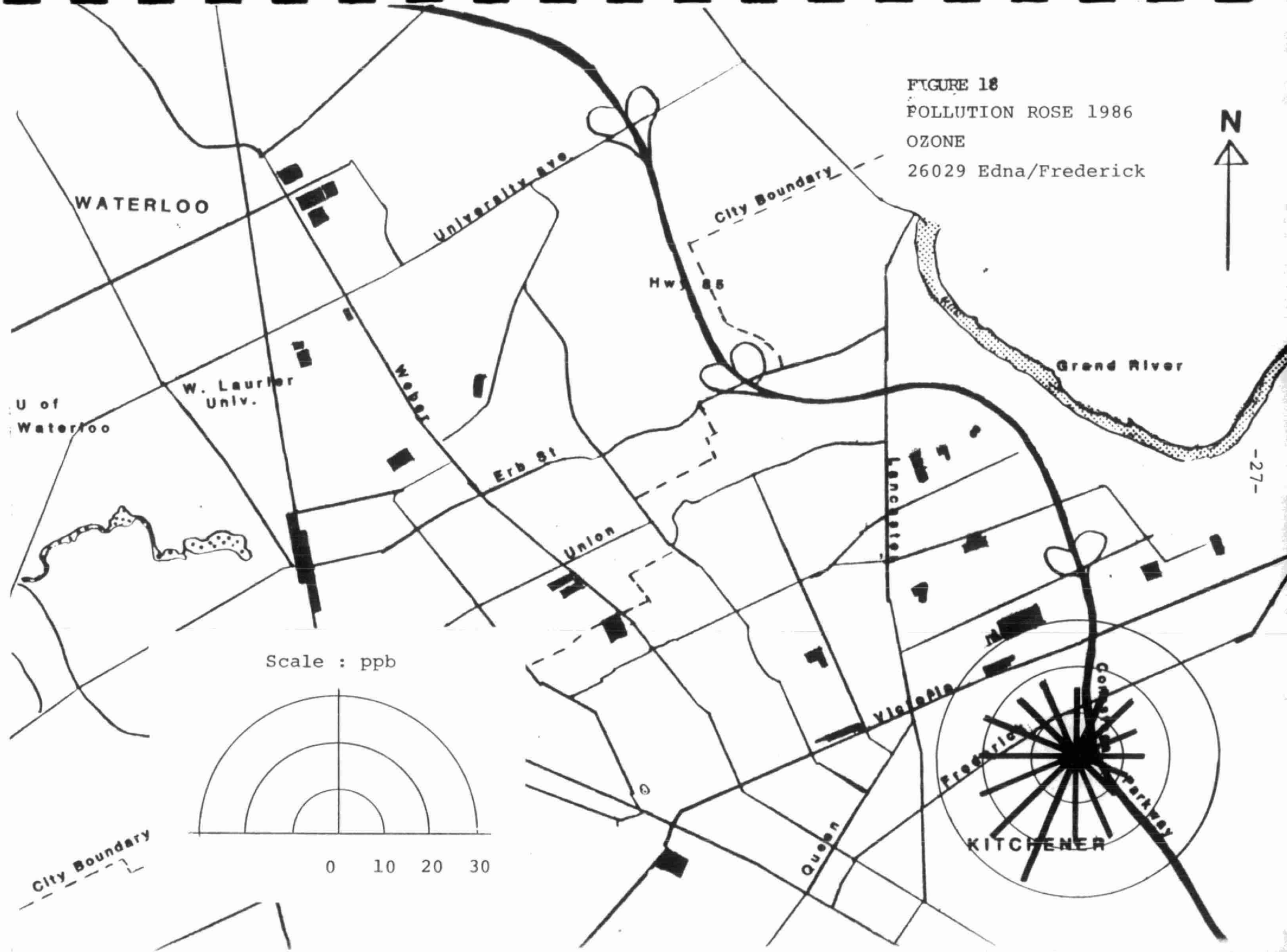
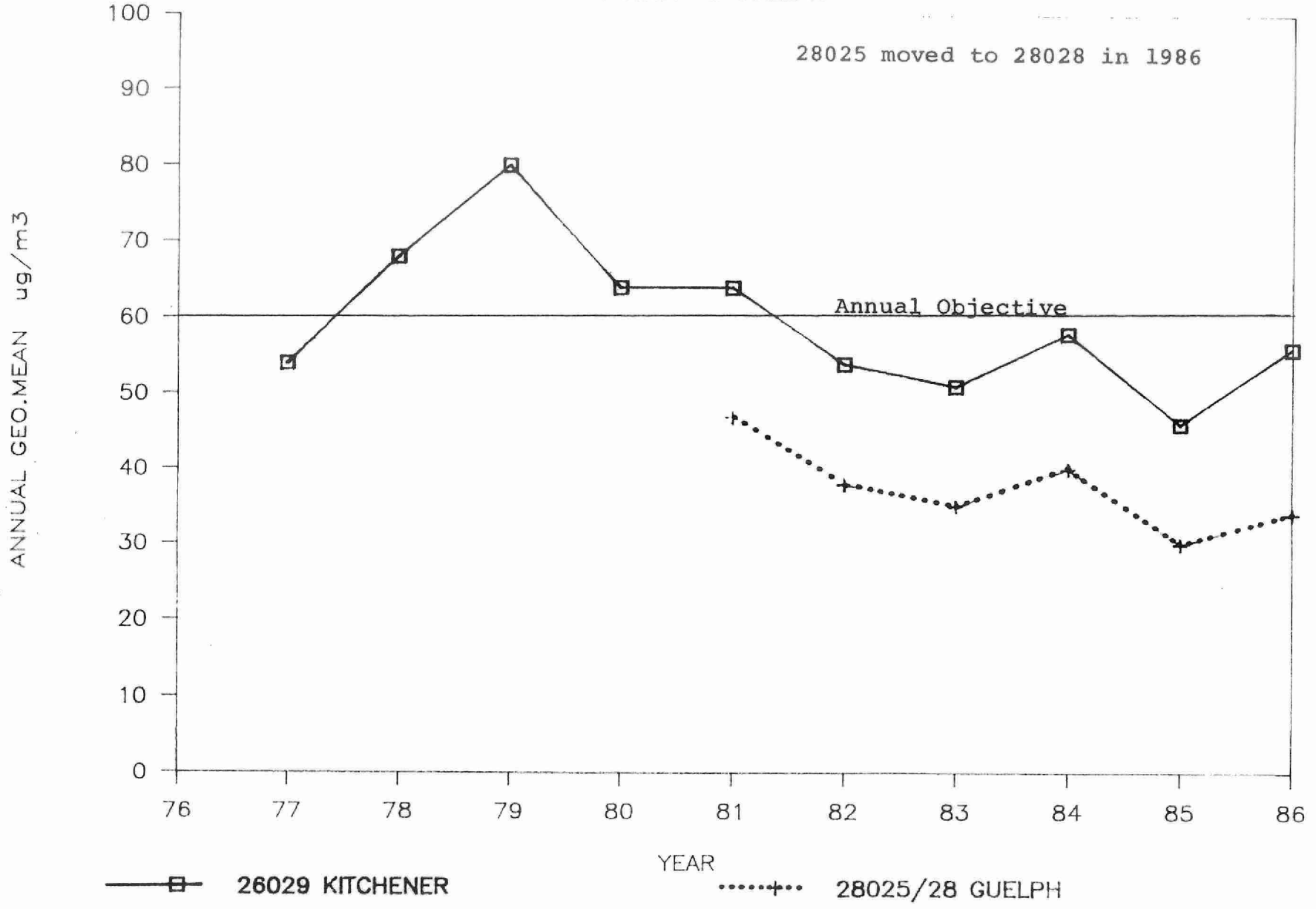


FIGURE 19

SUSPENDED PARTICULATES YEARLY TRENDS

KITCHENER & GUELPH



(Table 5), both on calm east wind days. Traffic from the Conestoga Parkway caused the readings. Further, as discussed in the Guelph section, annual trends between Kitchener and Guelph are identical, reflecting mesoscale phenomena, i.e., variations in long range emissions entering the area. The higher levels in Kitchener as compared to Guelph evident in Figure 19, are attributed to the Kitchener station's proximity to the adjacent Conestoga Parkway. Efforts are being made in 1987 to move the main Kitchener station away from the Parkway, in order to be more representative of the City.

Dustfall was monitored at Station 26040 on Guelph Avenue (Figure 10) near Hogg Fuel and Supply - a cement manufacturer. The company installed a baghouse to improve their emission control system, however, elevated concentrations above the monthly objective were found in 4 samples (Table 7).

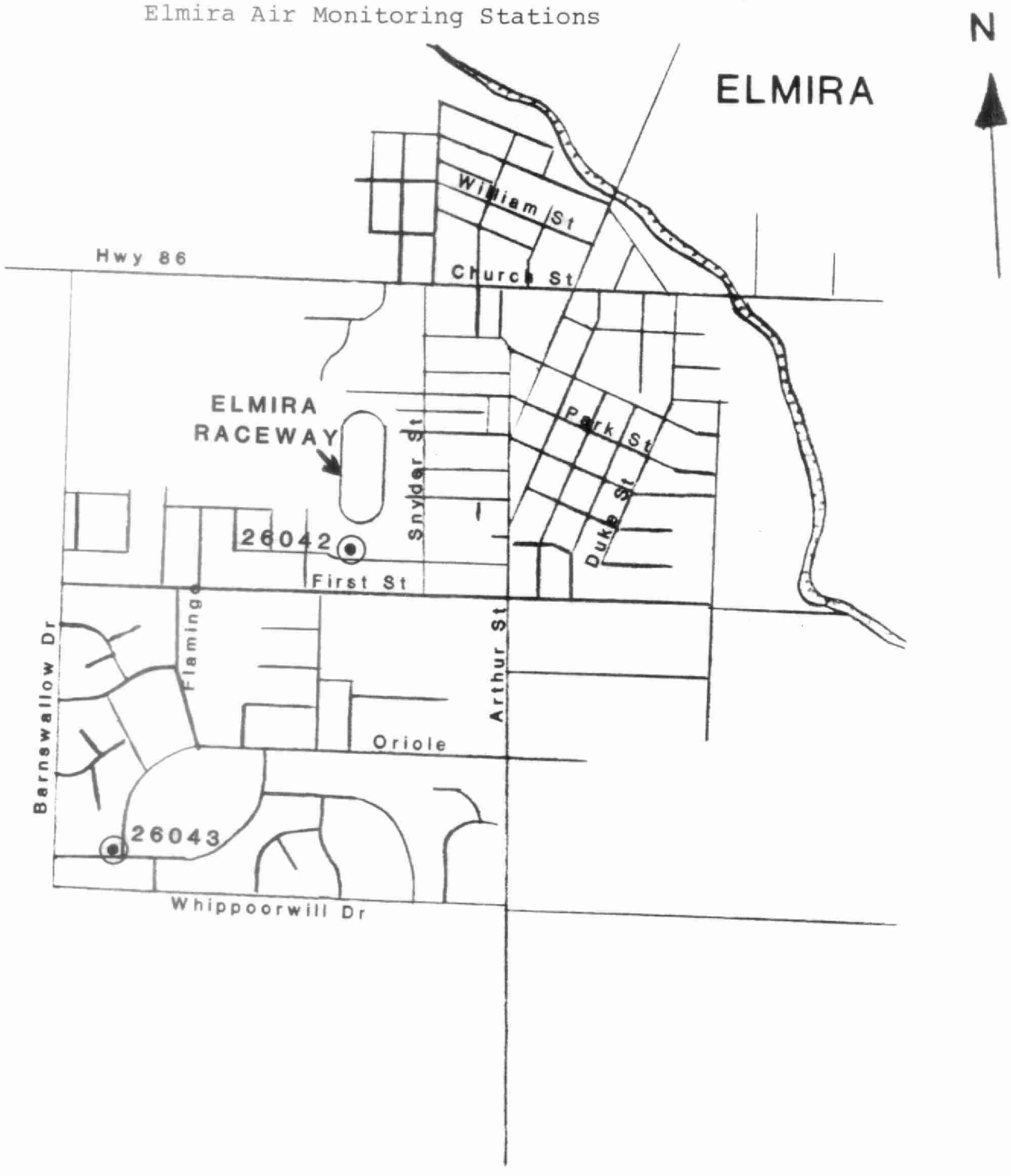
The siting of station 26040 led to problems in interpreting the data. Heavy tree and vegetation cover surrounded the station, possibly affecting the results. Consequently, a more intensive survey of the plant has been undertaken in 1987 by monitoring for suspended particulates with high volume samplers.

Elmira

Complaints of dust fallout from the Elmira Raceway prompted a survey with dustfall jars 26042 - Second St., adjacent to the Raceway and 26043 - Oriole/Mockingbird which acted as a control station remote from the track (Figure 20).

Data was collected from May to October 1987 and is summarized in Table 7. The Second St. jar (26042) recorded higher levels than the control location, however, only one sample marginally exceeded the monthly objective at 26042.

FIGURE 20
Elmira Air Monitoring Stations



DISCUSSION

This report has summarized the results of routine air monitoring in the Waterloo and Wellington areas. Where local industrial air pollution problems have been identified, the sources involved have been compelled to reduce their emissions through abatement programs or by Control Orders. Other sources monitored show little evidence of problem emissions but will continue to be carefully monitored.

General air quality as characterized by stations in downtown Guelph and Kitchener was very good.

In 1987, a new air quality data telemetry system has been installed throughout the Province. This new system will permit all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto. This will allow for data collection on a real-time basis. In the past, none of the stations in the Waterloo and Wellington areas were telemetered. In Guelph and Kitchener, both stations with continuous analyzers, required manual reading of strip charts for the data. (This process will continue until the telemetry system is functioning properly.) The chart reading causes delays in the availability of our data, amounting to several months. The new telemetry system will allow for immediate access to the data, both in the Regional Office in Hamilton and in Toronto and will also allow for remote control and maintenance of the instruments. As well, meteorological instruments will be installed, likely near Kitchener, providing wind and temperature data continuously for the area. All of this will result in a more efficient monitoring program.

Once the new system becomes operational, a new expanded Air Quality Index (AQI) will be added to the current API which refers to only two pollutants. The new AQI will be a function of six different pollutants, which will form up to 8 separate subindices. Concentrations of sulphur dioxide,

soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone will all be individually converted to the current scale of index numbers with the same advisory or alert levels as the current API, ie., 32, 50, 75 and 100. Not all stations will measure all of the parameters, but the highest subindex and the pollutant causing it will be reported several times daily to the public. In the Waterloo and Wellington area, the new AQI's will be reported for the existing Guelph station, the relocated Kitchener station and a new station in downtown Waterloo. The new system has the potential to add more communities in the future. The intent of the new index is to better inform the people of Ontario of air quality in their local area.

TABLE 1
SULPHUR DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .25
24-Hour - .10
1-Year - .02

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1986) 1-Hour	24-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	.003	.002	.003	.17	.03	0	0	General Ambient
28028 Exhibition Park* Guelph	.002	.003	.003	.06	.02	0	0	General Ambient

*Moved to 28028 in 1986 from downtown 28025 in January 1986

TABLE 2
OZONE
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 80

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Hour	NO. OF HOURS ABOVE OBJECTIVE 1984	1985	1986	SOURCE MONITORED
26029 Edna/Frederick Kitchener	18.3	19.9	17.0	116	6	27	33	General Ambient
28028 Exhibition Park Guelph	-	-	22.7	102	-	-	24	General Ambient

TABLE 3
CARBON MONOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - 30
8-Hour - 13

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1986) 1-Hour	8-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	.9	.8	.9	9	4	0	0	General Ambient

TABLE 4
NITROGEN DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objective: 1-Hour - .20
24-Hour - .10

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Hour	24-Hour	NO. OF HOURS ABOVE OBJECTIVE(1986) 1-Hour	24-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	.027	.029	.032	.13	.09	0	0	General Ambient

TABLE 5
SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: 24-Hour - 120
1-Year Geo. Mean - 60

LOCATION	GEOMETRIC MEAN 1984	1985	1986	1986 MAXIMUM	% OF SAMPLES OVER 120 (1986)	SOURCE MONITORED
28028 Exhibition Park* Guelph	40	30	34	86	0%	General Ambient
28027 Sewage Tr. Plant Guelph	63	61	53	230	9%	Dolime
26029 Edna/Frederick Kitchener	58	46	56	154	4%	General Ambient

*Moved to 28028 from downtown 28025 in January 1986

TABLE 6
CARBONATE IN SUSPENDED PARTICULATE
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: None

LOCATION	GEOMETRIC MEAN 1985	1986	MAXIMUM 1985	1986	SOURCE MONITORED
28027 Sewage Tr. Plant Guelph	0.59	0.52	6.4	9.1	Dolime

TABLE 7
DUSTFALL
UNIT - GRAMS/SQUARE METRE/30 DAYS

Ontario Objectives: 1-Month - 7.0
1-Year - 4.5

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Month	NO. OF MONTHS ABOVE OBJECTIVE 1984	1985	1986	SOURCE MONITORED
26026 Stanley Street Ayr	inv.*	inv.*	5.4^{3}	6.8	-	-	0	Date Industries Foundry
26036 Fountain Road Breslau	8.6	5.5	5.2	8.4	9	2	5	Breslube
26040 Guelph Avenue Kitchener	6.2^{11}	7.3	6.5	15.8	6	6	4	Hogg Fuel and Supply
26042 Second St. Elmira	-	-	6.0^{5}	7.3	-	-	1	Elmira Raceway
26043 Oriole/Mockingbird Elmira	-	-	2.5^{6}	4.1	-	-	0	Elmira background

11 - Numerical exponent refers to number of valid monthly samples when less than 12.

* - Dustfall jar 26026 yielded invalid data up to September 1986 due to improper siting of station.

TABLE 8
CALCIUM CONTENT IN DUSTFALL
UNIT - GRAMS/SQUARE METRE/30 DAYS

LOCATION	ANNUAL AVERAGE 1984	1985	1986	1986 MAXIMUM 1-Month	SOURCE MONITORED
26036 Fountain Road Breslau	.53	.47	.70	1.80	Breslube

DATE	ISSUED TO